

## **THE CAUSALITY BETWEEN TAX AND SPEND OF THE PUBLIC SECTOR IN MAURITIUS: A VECM APPROACH**

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### ***Abstract***

While this paper tries to fill a particular niche in the literature on the tax and spend nexus of the public sector, it provides new insights on the causality between public expenditure and public revenue from a small island developing economy perspective. We apply the Johansen technique to uncover the dynamics characterising the public sector's decision-making process with respect to taxing and spending. In particular, data covering the period 1970-1999 are used to test this causal link by applying a Vector Error Correction Mechanism (VECM).

It is found that unidirectional causality runs from public revenue to public expenditure. This result, which is consistent both in the short run and the long run, implies that the government taxes first and then spends. Further, an important implication of our result is that the lack of evidence in favour of fiscal synchronization (bi-directional causality between tax and spend) would make it easier for the fiscal authority to dictate either its revenue or spending plans, hence making fiscal policy a stable and an effective tool for demand management in Mauritius.

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## **1. Introduction**

In the public finance literature, a subject matter that has gained much importance over the past two decades is the synchronization of fiscal action; which is about the sequencing of government's taxing and spending plans. Put differently, this pertains to whether the government has to raise tax revenue first and then spends or vice-versa. The timing of this fiscal action is an important element especially because public revenue and public expenditure are tools of fiscal policy and an understanding of their inter-relationship or independence is an essential aspect in policy formulation. In particular, for countries running huge fiscal imbalances, it might contribute to the formulation of specific policies with regard to demand management. In fact the theoretical underpinnings of the causal link between these two variables are diverse as they are associated with different schools of economic thought. Needless to add, the corresponding divergences of views and tenets provide the alternative approaches to the hypothesis under inspection. From a Keynesian perspective, for instance, it is a stylized fact to spend first and then tax.

This is based on the principle of compensatory finance, whereby fiscal deficits are created to boost up the level of economic activity. Subsequently, through a built-in mechanism, the budgetary multiplier effect would itself eliminate any output gap and ensure a higher tax base, from which the extra tax revenue would be generated to offset the initially created fiscal deficit. Hence, the spend and then tax rule characterizes this Keynesian advocacy.

On the other hand, classical economists believe in what is known as fiscal neutrality, that is, the budget must always balance. A strong implication of this proposition is that the government must ensure that its expenditure does not exceed its revenue proceeds. This tenet is based on the premise that any mismatch between public expenditure and public revenue could have distortionary effects on the smooth operation of the price mechanism. Hence fiscal neutrality in this context dictates a tax and then spend paradigm. As one would

expect this hypothesis diametrically opposes that of the Keynesian<sup>1</sup>. What mediates both these extremes is the fiscal synchronization hypothesis, a situation where the motivation to tax and to spend is determined simultaneously. Lindahl (1958) and Musgrave (1966) had pointed out a third possibility in the timing of this fiscal action. While Lindahl used the concept of Benefit Principle to tax (see Brown and Jackson (1991) for a concise analysis) to justify the simultaneous determination of tax and spend, Musgrave argued its essence in the fiscal federalism context, more precisely, in the valuation of municipal services whereby causality runs from both sides between raising local taxes and raising local expenditures.

Empirically, the timing between tax and spend is tested using standard causality tests. Granger causality tests have indeed been used to analyse this relationship in the 1970s and 1980s. However, with the advancement in time series econometrics, gradually, co-integration and Error Correction Models (ECM) have been developed to improve on the spurious regression results that were generated in previous studies. Moreover, ECM-based causality tests have emerged that provide more robust results and refinements in understanding the causal links between public revenue and public spending. Indeed, current empiricism on this issue remains mixed.

While Von Furstenberg et al. (1985), Manage and Marlow (1986), Miller and Russek (1990) and Owoye (1995) have found evidence in favour of the fiscal synchronization hypothesis, that is, bi-directional causality between tax and spend, Bohm (1991) and Baghestani and Mcnown (1994) have established no causal link between these two variables. Hoover and Sheffrin (1992) and Vamvoukas (1997) have observed that causality between public revenue and public

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<sup>1</sup> Barro (1974) used an inter-temporal framework characterised by overlapping generations model to show that consumers treat current public debt and future tax liabilities as equivalent. In this way, government may follow a spend and then tax rule, by taxing less today and raising tax levels in future. Since little evidence exists in favour of Barro (1974) for developing countries (Seater (1993)), the Keynesian hypothesis is more relevant in such countries.

expenditure is highly susceptible to the time period under inspection. Consolidated data therefore over a long period might not be indicative of such hidden trends.

Hence, in this paper, we extend the literature by firstly providing additional empirical evidence on this issue using data pertaining to the Mauritian economy in the post-independence period; and, secondly, applying the recent developments in time series econometrics to analyse the behaviour of budgetary aggregates. The case of Mauritius is interesting given that it is a small open island economy in which the fiscal agent has been playing a major role in its economic progress since Independence in 1968. Furthermore, it is one of the few African economies that have shown remarkable growth performance in recent years with an average real growth rate performance of 5%. While public revenue has increased due to improvements in the tax base, public expenditure has also been soaring quite rapidly to cater for the growing welfare needs of the population.

The current size of the public sector, measured in terms of public expenditure as a ratio of GDP is found to be 23%. Moreover, fiscal deficits constitute a recurrent feature of the public finances in the country, and often exceeded 5% of GDP in the past few decades. In fact, in the 1970s the emphasis was more on the demand management framework as opposed to that of the late 1980s, which was more of a supply-side approach, combined with more market-friendly strategies. This was done in an attempt to restructure the public finances and restore macroeconomic confidence in the economy.

As an overview of the budgetary process, it is good to note that around 80% of the public revenue of the Mauritian economy come from expenditure or indirect taxes. Non-tax revenue represents an insignificant proportion of overall revenue given that public investment in income generating assets is not substantial and surpluses from nationalised industries are largely inexistent. At the beginning of financial year 2000-01, about 80% of total government expenditure were financed out of taxation and the remaining from

PSBR (Public Sector Borrowing Requirement). Average rate of taxation is equal to 17.3% of the economy's GDP.

Regarding expenditure, which represents around 22% of GDP, the government has been massively investing in human capital and in particular education. The latter absorbs 17% alone while health and social security share 8.3% and 21% respectively of the overall expenditure budget, the most expensive one. In addition, there is a major disparity between current and capital expenditure.

The ratio is 4:1. Actually, fiscal imbalances emanating from public policies over the recent years have been clustering around 4%-6%. The prevalence of these fiscal deficits could be attributed to the fact that government has been involved in long-term public investment projects in infrastructure, construction of schools and health centres along with the promotion of tertiary education. Such capital expenditure projects have been financed mostly out of domestic as well as foreign borrowings. Tax proceeds have been by and large appropriated to finance current expenditure of the government.

Given such trends, it would be difficult for one to ascertain whether the government has been using a policy of spend and tax or tax and spend rule or whether spend and tax decision was jointly determined. We therefore set on to investigate this causal link in the next section and comment on the relevant findings for the design of policies. The remaining parts of the paper are organized as follows: in section 2, a model is discussed to test the causality between tax and spend, in section 3, the data are analysed, altogether with the empirical estimates and in section 4 we conclude.

## **2. A Vector Error Correction Model (VECM)**

In order to test for any of the above paradigms, standard trivariate causality à la Granger (Granger (1969), (1981)) can be carried out between government spending, government revenue and a control variable national income. We believe that the inclusion of this third variable would be to capture the effects of tax on public spending via output and vice-versa. It is a well-known fact that with

macroeconomic variables it is difficult to rule out endogeneity and more so with national income data. Changes in income can affect either tax revenues or public expenditures, which can in turn, affect their counterparts in a second round (See Vamvoukas (1997) for a more detailed account of the inclusion of this variable in a parallel study. Given that we are dealing with time series data, the possibility of non-stationarity of variables cannot be ruled out.

Therefore, we propose further to use multivariate co-integration technique based on Johansen (1988) to study the relationship between tax and spend. Within this technique, we will also carry out further analyses through impulse responses pertaining to the observed dynamic relationships captured respectively by VECM. The VECM methodology which constitutes the core of our testing procedures can be theoretically represented as follows;

$$(1-\ell)\log E_t = a_0 + a_1 \mathbf{e}_{t-1} + \sum_{j=1}^{n_1} \mathbf{a}_j (1-\ell)\log E_{t-j} + \sum_{j=1}^{n_2} \mathbf{b}_j (1-\ell)\log T_{t-j} + \sum_{j=1}^{n_3} \mathbf{I}_j (1-\ell)\log Y_{t-j} + u_t \quad (1)$$

$$(1-\ell)\log T_t = b_0 + b_1 \mathbf{w}_{t-1} + \sum_{j=1}^m \mathbf{J}_j (1-\ell)\log E_{t-j} + \sum_{j=1}^{m_1} \mathbf{q}_j (1-\ell)\log T_{t-j} + \sum_{j=1}^{m_2} \mathbf{j}_j (1-\ell)\log Y_{t-j} + v_t \quad (2)$$

Where  $\mu$  and  $\nu$  are uncorrelated error terms and  $E(u_t, u_s)=0$ ,  $E(v_t, v_s)=0$  for all  $t, s$ ,  $E$ = Government Expenditure,  $T$ = Government Tax Revenue,  $m_1$  and  $m_2$  stand for the maximum lag lengths and  $\ell$  is the usual lag operator. Here it is to be noted that in both these equations the lagged error terms have been included. They are inserted here as error correction terms pertaining to our co-integrating regressions. While  $\mathbf{e}_{t-1}$  is the one -period lagged value of  $\mathbf{e}_t$ , obtained from the co-integrating equation of  $E$  on  $T$  and  $Y$ ;  $\mathbf{w}_{t-1}$  is

the one-period lagged value of  $w_t$ , obtained from the co-integrating equation of T on E and Y. In this framework, the optimum lag-length can be derived on the basis of Akaike's Information Criterion. Moreover, for causality to run from tax to spend, the coefficients  $a_1$ , all the  $b_j$  s and the coefficients of Y, the  $I_j$  s have to be significant altogether. Similarly, we can capture the causality from spend to tax whenever the coefficients  $b_1$ , all the  $j_j$  s and all the  $J_j$  s are jointly significant. In addition, if evidence in favour of the fiscal synchronization hypothesis is found, then all the coefficients mentioned above are expected to be significant.

### 3. Data and estimation issues

The data used in this exercise pertain to the Government Finance Statistics (annual issues). The sample period covered is 1970 to 1999 which represents an active post independence period over which the Mauritian economy has evolved socially, economically and politically. Before proceeding further with our analysis, we investigate into the possibility of non-stationarity of the variables E, T and Y.

We apply the Augmented Dickey-Fuller (ADF) test proposed by Dickey and Fuller (1979, 1981) to firstly ascertain the order of integration of each variable. This test is defined as:

$$\Delta \log E_t = a_0 + a_1 t + a_2 \log E_{t-1} + \sum_{i=1}^m b_i \Delta \log E_{t-1} + y_t$$

Where  $t$  is a time trend and  $y$  is assumed to be identically and independently distributed. Choice of  $m$  largely depends on the number of available observations and the maximised value of Akaike's Information Criterion (AIC) to determine the optimum lag length. The ADF test is applied to our variables, namely, E, T and Y and it is found that the null-hypothesis of non-stationarity could not be rejected for all the three variables. The results are reported in Table 1 below.

Table 1: Unit Root tests of Variables

Variable	ADF Statistic
$\log E_t$	-2.47
$\Delta \log E_t$	-3.66*
$\log T_t$	-1.99
$\Delta \log T_t$	-5.92*
$\log Y_t$	0.21
$\Delta \log Y_t$	-4.12*

\*Significant at 5% (see Mac Kinnon's (1991))

Thus, all variables are integrated of order 1, as they become stationary after first difference, as shown in the above table. Further, we investigate into the possibility of any long run relationship between E, T and Y using the Johansen co-integration technique. We proceed to establish the co-integrating vector(s) in the relationship  $T_t = f(E_t, Y_t)$ . We observe that a unique co-integrating vector exists between T, E and Y and this is based on both the Maximal Eigenvalue test or Trace test statistics at 5% level of significance from regressions with restricted intercepts and no trends. The results are shown in the following tables (Table 2(a) and Table 2(b)).

Table 2(a) Co-integration Results Based on Maximal Eigenvalue Statistic

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
$r=0$	$r=1$	48.68	22.04	19.86
$r \leq 1$	$r=2$	13.25	15.87	13.81
$r \leq 2$	$r=3$	6.8	9.16	7.53

Notes: (i) Dependent variable is T; (ii) Eigen values used in descending order are: 0.85, 0.39, 0.23 and 0.00 and (iii) Order of VAR is 4 (determined from AIC).



**Table 2(b) Co-integration Results Based on Trace Statistic**

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
$r = 0$	$r = 1$	48.68	22.04	19.86
$r \leq 1$	$r = 2$	13.25	15.87	13.81
$r \leq 2$	$r = 3$	6.8	9.16	7.53

Notes: (i) Dependent variable is T; (ii) Eigen values used in descending order are: 0.85, 0.39, 0.23 and 0.00 and (iii) Order of VAR is 4 (determined from AIC).

Having established that a long-term relationship does indeed exist between E, T and Y, we thus proceed to provide estimates of the dynamics that characterise this unique relationship. We report the empirical coefficients of the VECM for each variable, Government Expenditure (E) and Government Revenue (T), in Table 3 below. In this ECM-based causality exercise, it is good to remember that Y plays the role of a control variable, and tends to track any additional feedback effect which the endogenous variable may have on the dependent variable. The optimal lag length in the two equations, based on AIC, is set at 3.

We can find that it is only in the 'ΔE' equation that the lagged value of the residual is significant. In general, the coefficients in the tax equation are insignificant and it appears that neither public expenditure nor GDP turn out to explain changes in tax revenue. This finding is consistent with Sobhee (1999) and Sobhee (2003) reporting discretionary measures in raising tax and isolation of tax changes against income fluctuations given that around 80% of tax revenue come from indirect taxation.

Table 3: Vector Error Correction Model Results for Variables E and T

<i>Explanatory Variables</i>	Dependent Variable: $\Delta T$		Dependent Variable: $\Delta E$	
	<i>Coefficient</i>	<i>t-ratio</i>	<i>Coefficient</i>	<i>t-ratio</i>
$\Delta E(-1)$	0.11	0.21	1.4	5.4*
$\Delta E(-2)$	-0.002	-0.005	0.88	4.8*
$\Delta E(-3)$	0.28	0.75	0.8	4.4*
$\Delta T(-1)$	0.5	1.2	-0.4	-1.9**
$\Delta T(-2)$	-0.18	-0.47	-0.1	-0.56
$\Delta T(-3)$	-0.75	-2.13*	-0.38	-2.2*
$\Delta Y(-1)$	-0.79	-1.34	-1.4	-5.04*
$\Delta Y(-2)$	1.04	1.19	-1.0	-2.5*
$\Delta Y(-3)$	0.15	0.27	0.27	0.98
ECM(-1)	-0.41	-0.94	-1.4	-6.4*
Diagnostics	$\bar{R}^2 = 0.35$ ; F = 2.5 LM = 0.35 (0.54) RESET = 4.1 (0.1) JB = 3.39 (0.18) ARCH = 0.02(0.88)		$\bar{R}^2 = 0.72$ ; F = 8.3 LM = 2.2 (0.14) RESET = 2.4 (0.12) JB = 1.3 (0.53) ARCH = 0.04 (0.85)	

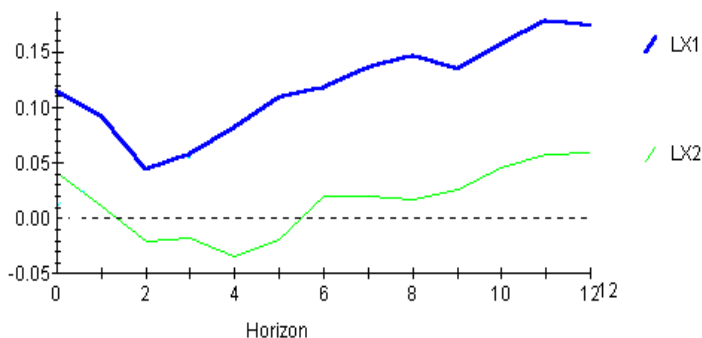
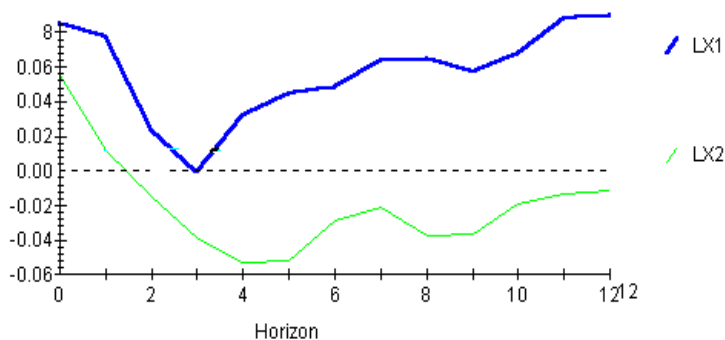
Notes: (i) \* indicates significance at less than 5%, \*\* indicates significance at less than 10%; (ii) LM refers to the Lagrange Multiplier statistic for serial correlation, RESET refers to Ramsey's test of misspecification of the functional form, JB is the Jarque Bera test of normality of residuals and ARCH represents the test for Autoregressive Conditional Heteroscedasticity (iii) the probability value of each diagnostic test is given in brackets and is within the acceptable norms (iv) The ECM term emanates from the co-integrating equation of the unique vector.

Alternatively, in the expenditure equation we find that both tax changes and income changes do explain variations in public spending plans. This would imply an expenditure system dependent directly and indirectly (via the administrative penetration) on tax collections.

Moreover, the finding is consistent in both the short run and the long run. However, to have more insights through the causal links between these two variables, we proceed with the usual F tests of zero restrictions. In the first equation, the joint test of zero restriction was imposed on coefficients  $a_1$ , the  $b_j$ s and the  $I_j$ s, whereas in the second equation, the restriction was imposed on coefficients  $b_1$ , the  $j_j$ s and the  $J_j$ s. It is found that the test of restriction was valid in the ' $\Delta T$ ' equation and not in the ' $\Delta E$ ' equation, clearly implying that unidirectional causality is found to exist between the two variables of interest and more particularly running from ' $\Delta T$ ' to ' $\Delta E$ '.

Hence, while changes in tax revenue precede changes in public expenditure, no evidence is found to support the contention that changes in public expenditure influence changes in tax revenue. From a policy standpoint therefore, the result obtainable by us indicates that the state can influence its spending patterns subject to changes in its tax structure and revenue outlay. Moreover, the lack of evidence in favour of the bi-directional causality between these two fiscal variables make fiscal policy a more stable tool than otherwise would be the case.

Besides, these findings can be further confirmed through the impulse responses in each equation. These can be tracked from the figures illustrated below (LX1 stands for the tax variable and LX2 represents the expenditure variable):

**Fig1a:** Generalized Impulse Response(s) to one S.E. shock in the equation for LX1**Fig1b:** Generalized Impulse Response(s) to one S.E. shock in the equation for LX2

Figures 1a and 1b illustrate the responses in each endogenous variable following a one standard error shock in the respective VECM equation. Over a horizon of 12 periods, it can be clearly observed in Figure 1a that the evolution of public spending follows the same trend as that of tax revenue. Initially, we observe a decline in both variables but subsequently an increasing trend is observed with public expenditure following suit as tax increases.

However, in Figure 1b we observe that seemingly both endogenous variables evolve in the same manner following the standard error shock in expenditure, but the periodic response is not very similar.

Tax changes do not necessarily respond with a lag or with lags to changes in public spending. What is more appealing is that expenditure changes rather precede changes in tax. In either direction therefore, we see that it is tax changes that induce expenditure changes and not vice-versa. Also, in either case, the shocks do not die out and persist over at least the 12 periods shown. Since our main focus is on tax and spend, we do not discuss the impulse responses of income following these shocks.

### **3. Conclusions**

The tax and spend, and spend and tax, paradigms are tested using a VECM over the period 1970 to 1999 using data pertaining to the public finances in Mauritius. Indeed, empirical results confirm that in this small island economy, the tax and spend paradigm holds, that is, the government first mobilizes the necessary tax revenue to make up its spending. This result is found to hold both in the short run and the long run and indicates that by and large the government wants to be careful in monitoring its spending plans conditional on the resources it has already mobilized.

However, the fact that the Mauritian public finances have been characterized by fiscal deficits on several occasions, we may not view the tax and then spend rule as a necessary mechanism to avoid budget deficits. It could just be a precautionary measure to avoid fiscal imbalances in general or a tool to dictate the course of public spending. Also, absence of the fiscal synchronisation hypothesis or the inter-dependence between these two fiscal variables makes it easier for the government to use either of them as a reliable instrument for policy decision-making than would be the case under interdependence or endogeneity.

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